

## **Claims**

What is claimed is:

1. A system for navigating a virtual body within a 3D virtual workspace, the system comprising;

an input drive control system operable to monitor changes in input variables associated with actions of a user input device; and

a workspace control system operable to provide a user with a viewing context having a position and orientation associated with states of a plurality of workspace variables, the input drive control system being coupled to at least one of the plurality of workspace variables, such that a selection of the at least one workspace variables allows for a single input motion of the user input device to change the state of the at least one workspace variable and deselection of the at least one workspace variable provides a change in the position and orientation of the viewing context, wherein the change takes place over time such that the user is made aware of the change in position and orientation of the viewing context.

2. The system of claim 1, wherein a travel control system couples the input drive control system to the at least one of the plurality of workspace variables based on a navigation type.

3. The system of claim 1, the input variables comprising speed, position and selection data.

4. The system of claim 1, the plurality of workspace variables comprising object state, environment state and virtual body state.

5. The system of claim 1, the input variables comprising speed of the user input device and the at least one of the plurality of workspace variables comprising the

state of the virtual body wherein the forward speed of the input device is coupled to the height and tilt of the virtual body such that the viewing context of the virtual body is continuously updated and moves from a local view to a global view of the 3D virtual workspace, wherein deselection of the user input device causes the position and orientation of the virtual body to glide down to a location within a viewing frustum along a ground plane in the 3D virtual workspace.

6. The system of claim 5, the location within a viewing frustum being a bottom of the viewing frustum.

7. The system of claim 5, the location within a viewing frustum being an object in the viewing frustum.

8. The system of claim 5, the height of the virtual body being limited by a ceiling within the 3D virtual workspace.

9. The system of claim 5, the input variables comprising speed, position and selection data and the plurality of workspace variables comprising object state and virtual body state wherein selection of an object animates the object to the center of the 3D virtual workspace, dragging the input device forward and backward moves the virtual body toward and away from the object, respectively, and dragging the input device left or right causes the virtual body to orbit around the object.

10. The system of claim 1, the at least one of the plurality of workspace variables being an object state, the input drive control system being coupled to the object state such that an object can be selected creating a copy of the object that is manipulated to a new position and orientation in the 3D virtual workspace wherein the viewing context assumes the new position and orientation of the copy of the object with respect to the object upon deselection of the object.

11. The system of claim 1, the at least one of the plurality of workspace variables being an object state, the input drive control system being coupled to the object state such that an object in a first viewing context can be selected creating a copy of the object that is manipulated to a new position and orientation in the 3D virtual workspace creating a second viewing context with the new position and orientation.

12. The system of claim 11, wherein multiple copies and multiple viewing contexts can be created by manipulating multiple copies of the object to various positions and orientations, each copy being destroyed upon deselection of the object.

13. The system of claim 1, the at least one of the plurality of workspace variables being an object state, the input drive control system being coupled to the object state such that an object in a viewing context can be selected wherein the viewing context is adjusted to the position and orientation of the object, thereby, possessing the object.

14. The system of claim 1, the at least one of the plurality of workspace variables being an object state and a virtual body state, the input drive control system being coupled to the object state and the virtual body state such that the state of at least one of objects within and objects outside a radius centered on a virtual body is changed to eliminate occlusions within the viewing context.

15. The system of claim 14, the state of the objects within the radius being changed to a transparent state.

16. The system of claim 14, the state of the objects within the radius being changed to a reduced size state.

17. The system of claim 16, the reduced size state of the object depending on the distance of the object from the virtual body.

18. The system of claim 14, the state of the objects outside the radius being changed to an enlarged size state.

19. The system of claim 18, the enlarged size state of the object depending on the distance of the object from the virtual body.

20. The system of claim 14, the radius being fixed and the virtual body state being movable through the 3D virtual workspace.

21. The system of claim 14, the radius being adjustable and the virtual body state being fixed in the 3D virtual workspace.

22. The system of claim 1, the at least one of the plurality of workspace variables being an environment state and a virtual body state, the input drive control system being coupled to the environment state and the virtual body state such that selection of the environment causes a ground plane of the environment to be compressed radially around a virtual body, the virtual body being navigable within the compressed ground plane.

23. A processor controlled display system for displaying a virtual 3D workspace comprising:

a processor;

a user input device coupled to the processor, the user input device providing signals indicating actions and requests of a system user to the processor;

a display device coupled to the processor, the display device being operable to displaying a 3D virtual workspace based on instructions from the processor; and

a memory having executable instructions stored therein wherein the processor in response to the instructions executes an animation loop routine which periodically calls one or more workspace routines for providing a viewing context of the 3D virtual workspace on the display device, the viewing context having an initial position and

orientation associated with the states of a plurality of workspace variables, the user input device being coupled to at least one of the plurality of workspace variables, such that a selection of the at least one workspace variables allows for a single input motion of the user input device to change the state of the at least one workspace variable and deselection of the at least one workspace variable provides a change in the position and orientation of the viewing context, wherein the change takes place over time such that the user is made aware of the change in position and orientation of the viewing context of the 3D virtual workspace on the display device.

24. The system of claim 23, the input device being coupled to the at least one of the plurality of workspace variables based on a navigation type.

25. The system of claim 23, the at least one of a plurality of workspace variables being the state of a virtual body, the speed of the user input device being coupled to the height and tilt of the virtual body within the 3D virtual workspace such that display is provided with a viewing context from the virtual body that moves from a local view to a global view of the 3D virtual workspace as the speed of the user input device is increased, wherein slowing down of the user input device in the forward direction causes the position and orientation of the virtual body to glide down to a location within a viewing frustum along a ground plane in the 3D virtual workspace.

26. The system of claim 25, the location within a viewing frustum being a bottom of the viewing frustum.

27. The system of claim 25, the location within a viewing frustum being an object in the viewing frustum.

28. The system of claim 25, the height of the virtual body being limited by a ceiling within the 3D virtual workspace.

29. The system of claim 25, the plurality of workspace variables comprising object state and virtual body state wherein selection of an object within the 3D virtual workspace with the user input device animates the object to a viewing context in the center of the 3D virtual workspace, dragging the input device forward and backward moves the viewing context from the virtual body toward and away from the object, respectively, and dragging the input device left or right orbits the viewing context from the virtual body around the object.

30. The system of claim 22, the at least one of the plurality of workspace variables being an object state, such that selecting an object within the 3D virtual workspace with the user input device creates a copy of the object that can be manipulated to a new position and orientation in the 3D virtual workspace wherein the viewing context assumes the new position and orientation of the copy of the object with respect to the object upon deselection of the object.

31. The system of claim 22, the at least one of the plurality of workspace variables being an object state, such that selecting an object within the 3D virtual workspace with the user input device creates a copy of the object that can be manipulated to a new position and orientation in the 3D virtual workspace creating a second viewing context with the new position and orientation.

32. The system of claim 31, wherein multiple copies and multiple viewing contexts can be created by manipulating multiple copies of the object to various positions and orientations, each copy being destroyed upon deselection of the object.

33. The system of claim 22, the at least one of the plurality of workspace variables being an object state, such that an object within the 3D virtual workspace can be selected by the user input device providing a new viewing context having the position and orientation of the selected object, thereby, possessing the object.

34. The system of claim 22, the at least one of the plurality of workspace variables being an object state and a virtual body state, such that the state of at least one of objects within and objects outside a radius centered on a virtual body is changed to eliminate occlusions within the viewing context.

35. The system of claim 34, the state of the objects within the radius being changed to a transparent state.

36. The system of claim 34, the state of the objects within the radius being changed to a reduced size state.

37. The system of claim 36, the reduced size state of an object depending on the distance of the object from the virtual body.

38. The system of claim 34, the state of the objects outside the radius being changed to an enlarged size state.

39. The system of claim 38, the enlarged size state of an object depending on the distance of the object from the virtual body.

40. The system of claim 34, the radius being fixed and the virtual body state being movable through the 3D virtual workspace.

41. The system of claim 34, the radius being adjustable and the virtual body state being fixed in the 3D virtual workspace.

42. The system of claim 22, the at least one of the plurality of workspace variables being an environment state and a virtual body state, such that selection of the environment of the 3D virtual workspace causes a ground plane of the 3D virtual workspace to be compressed radially around a viewing context of a virtual body, the

virtual body being navigable within the compressed ground plane of the 3D virtual workspace.

43. A computer implemented method for implementing a 3D virtual environment comprising;

displaying a plurality of virtual 3D objects within a 3D virtual environment, the 3D virtual environment having an initial viewing context with an initial position and orientation from a virtual body;

coupling signals associated with actions of a user input device to a state of at least one workspace variable, the at least one workspace variable being at least one of the plurality of virtual 3D objects, the 3D virtual environment and the virtual body;

selecting the at least one workspace variable;

changing the state of the at least one workspace variable in response to actions of the user input device;

deselecting at least one workspace variable; and

changing the position and orientation over time of the viewing context of the viewing context based on the changing of the state of the at least one workspace variable.

44. The method of claim 43, further comprising determining a navigation type and coupling signals associated with actions of a user input device to a state of at least one workspace variable based on a navigation type.

45. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprising coupling signals associated with actions of a user input device to the state of the virtual body, the forward speed of the user input device being coupled to the height and tilt of the virtual body within the 3D virtual environment such that position and orientation of the viewing context from the virtual body moves from a local view to a global view of the 3D virtual environment as the speed of the user input device is increased, wherein slowing down the forward speed of the user input device causes the position and orientation of the viewing



context from the virtual body to glide down to the bottom of a viewing frustum along a ground plane in the 3D virtual environment.

46. The method of claim 45, the location within a viewing frustum being a bottom of the viewing frustum.

47. The method of claim 45, the location within a viewing frustum being an object in the viewing frustum.

48. The method of claim 45, the height of the viewing context being limited by a ceiling within the 3D virtual environment.

49. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of an object and a state of the virtual body wherein selection of an object within the 3D virtual environment animates the object to a viewing context in the center of the 3D virtual environment, dragging the input device forward and backward moves the viewing context from the virtual body toward and away from the object, respectively, and dragging the input device left or right orbits the viewing context from the virtual body around the object.

50. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of an object, such that selecting the object with the user input device creates a copy of the object that can be manipulated to a new position and orientation in the 3D virtual environment wherein the viewing context assumes the new position and orientation of the copy of the object with respect to the object upon deselection of the object.

51. The method of claim 43, wherein coupling signals associated with actions

of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of an object, such that selecting an object with the user input device creates a copy of the object that can be manipulated to a new position and orientation in the 3D virtual environment creating a second viewing context with the new position and orientation.

52. The method of claim 51, wherein multiple copies and multiple viewing contexts can be created by manipulating multiple copies of the object to various positions and orientations, each copy being destroyed upon deselection of the object.

53. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of an object, such that an object within the 3D virtual environment can be selected by the user input device providing a new viewing context having the position and orientation of the selected object, thereby, possessing the object.

54. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of at least one object and a state of the virtual body, such that the state of at least one of objects within and objects outside a radius centered on a virtual body is changed to eliminate occlusions within the viewing context.

55. The method of claim 54, the state of the objects within the radius being changed to a transparent state.

56. The method of claim 54, the state of the objects within the radius being changed to a reduced size state.

57. The method of claim 56, the reduced size state of an object depending on the distance of the object from the virtual body.

58. The method of claim 54, the state of the objects outside the radius being changed to an enlarged size state.

59. The method of claim 58, the enlarged size state of an object depending on the distance of the object from the virtual body.

60. The method of claim 54, the radius being fixed and the virtual body state being movable through the 3D virtual environment.

61. The method of claim 54, the radius being adjustable and the virtual body state being fixed in the 3D virtual environment.

62. The method of claim 43, wherein coupling signals associated with actions of a user input device to a state of at least one workspace comprises coupling signals associated with actions of a user input device to a state of the 3D virtual environment and a state of the virtual body, such that selection of the environment causes a ground plane of the 3D virtual environment to be compressed radially around a viewing context of a virtual body, the virtual body being navigable within the compressed ground plane of the 3D virtual environment.

63. The method of claim 43, wherein changing at least one of the position and orientation of the viewing context based on the changing of the state of the at least one workspace variable being accomplished in a single input motion of the user input device.

64. A system for navigating a virtual body within a 3D virtual workspace for identifying objects within the 3D virtual workspace, the system comprising;  
means for displaying a 3D virtual workspace having a plurality of virtual 3D

objects and a viewing context from a virtual body, the viewing context having an initial position and orientation;

means for coupling signals associated with actions of a user input device to a state of at least one workspace variable;

means for changing the state of the at least one workspace variable in response to actions of the user input device; and

means for changing the position and orientation of the viewing context over time based on the changes of the state of the at least one workspace variable.

65. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable coupling forward speed of the user input device to the height and tilt of the virtual body within the 3D virtual workspace.

66. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for orbiting a selected object.

67. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for creating a copy of a selected object that can be manipulated to a new position and orientation in the 3D virtual workspace wherein the viewing context assumes the new position and orientation of the copy of the selected object with respect to the object upon deselection of the object.

68. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for creating at least one copy of the object that can be manipulated to a new position and orientation in the 3D virtual workspace creating at least one additional viewing context with the new position and orientation.

69. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for possessing an object.

70. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for eliminating occlusions within the viewing context.

71. The system of claim 64, the means for coupling signals associated with actions of a user input device to a state of at least one workspace variable further comprising means for compressing a ground plane of the 3D virtual workspace around a viewing context of a virtual body.

72. A computer-readable medium having computer-executable for performing the steps comprising;

displaying a 3D virtual workspace having a plurality of virtual 3D objects and a viewing context from a virtual body, the viewing context having an initial position and orientation;

coupling signals associated with actions of a user input device to a state of at least one workspace variable;

changing the state of the at least one workspace variable in response to actions of the user input device; and

changing the position and orientation of the viewing context over time based on the changes of the state of the at least one workspace variable.